CLAIMS

WHAT IS CLAIMED IS:

1. Apparatus for detecting structural damage to a composite pressure vessel, the apparatus comprising:

an optical fiber adhered to an exterior surface of the composite pressure vessel; and,

a detector operable to detect damage to the fiber that is representative of damage to the vessel.

2. The apparatus of claim 1, wherein the detector comprises:

an injector operable to inject a light signal into an end of the optical fiber; and,

a detector operable to detect the light signal at an end of the optical fiber.

3. The apparatus of claim 2, further comprising:

a comparator operable to compare first and second light signals injected into the optical fiber at different times.

4. The apparatus of claim 2, wherein the light signal injector and detector are both coupled to a first end of the optical fiber, and wherein a second end of the optical fiber comprises a reflector operative to reflect a light signal injected into the first end of the optical fiber back to the first end thereof.

5. The apparatus of claim 4, further comprising a fiber optic connector at the first end of the optical fiber.

6. The apparatus of claim 4, wherein the light signal injector further comprises a pulser operable to pulse the light signal injected into the optical fiber.

7. The apparatus of claim 2, wherein the light signal injector comprises a laser or a light emitting diode.

8. The apparatus of claim 2, wherein the light signal detector comprises a PIN diode or an avalanche photodiode.

9. The apparatus of claim 1, wherein the optical fiber includes a core comprising silica or a polymer.

10. The apparatus of claim 1, wherein the optical fiber is adhered to the exterior surface of the composite pressure vessel with a resin.

11. The apparatus of claim 10, wherein the optical fiber is embedded in the resin.

12. The apparatus of claim 1, wherein the composite pressure vessel comprises a composite overwrapped pressure vessel ("COPV").

13. The apparatus of claim 1, wherein the composite pressure vessel comprises a high pressure gas storage vessel, a liquid propellant tank, or a solid rocket motor case.

14. A method for detecting structural damage to a filament wound composite pressure vessel, the method comprising:

winding an optical fiber on and adhering it to an exterior surface of the composite pressure vessel;

injecting first and second light signals into an end of the optical fiber at different times;

detecting the first and second light signals at an end of the optical fiber; and,

comparing the first and second light signals with each other.

15. The method of claim 14, further comprising:

injecting a light signal into a first end of the optical fiber;

reflecting the light signal from an opposite second end of the optical fiber; and,

detecting the reflected light signal at the first end of the optical fiber.

16. The method of claim 15, further comprising;

providing a two-dimensional map of the optical fiber on the exterior surface of the composite pressure vessel;

detecting a reflected light signal corresponding to a discontinuity in the optical fiber;

measuring the amount of time taken by the reflected light signal to travel from the first end of the fiber to the discontinuity and back to the first end;

computing the distance of the discontinuity from the first end of the optical fiber from the time taken; and,

locating the discontinuity on the map.

17. The method of claim 16, wherein the light signal comprises a pulsed light signal.

18. The method of claim 14, wherein winding the optical fiber comprises winding the fiber while it is wetted with a liquid resin, and wherein adhering the optical fiber comprises curing the liquid resin.

19. The method of claim 14, wherein the optical fiber is wound on the composite pressure vessel in a uniform, two-dimensional pattern in which adjacent windings are spaced at a selected distance from each other.

20. The method of claim 19, wherein the winding pattern comprises at least one of helical and axial windings.